DISEASES and INSECT PESTS of RASPBERRIES and OTHER CANE FRUITS

630.4
C212
pub 880
1964 C3

CANADA DEPARTMENT OF AGRICULTURE PUBLICATION 880 1964

KEY TO THE DISEASES AND DISORDERS

The number at the right is the one under which the disease is discussed in the text.

A. Symptoms on the leaves

- a. Leaves distorted
  - 1. Irregular yellow-green blotches or mottling. Surface sometimes crumpled **Mosaic** (1)
  - 2. Tightly curled, brittle leaves on new canes **Leaf Curl** (2)
- b. Irregular, large brown blotches **Spur Blight** (3)
- c. Regular, more or less round spots
  - 1. Spots small, with dark borders and light-gray centers **Anthracnose** (4)
  - 2. Spots numerous, small, reddish brown turning to gray **Leaf Spot** (5)
- d. Clusters of powdery yellow spores on undersides of leaves
  - 1. Early in season **Yellow Rust** (6)
  - 2. In July or August **Late Yellow Rust** (6)
- e. White pustules
  - 1. White blisters in spring, later breaking to expose orange spores **Orange Rust** (7)
  - 2. Small and yellow at first, later white; on evergreen blackberry **White Rust** (8)
- f. White powdery growth, usually on undersides of leaves **Powdery Mildew** (9)
- g. Leaves discolored **Mineral Deficiency** (19)

B. Symptoms on canes

- a. Canes wilt and die
  - 1. New canes
    - (i) Canes become dark blue or purple; leaves wilt, turn yellow, and drop **Verticillium Wilt** (10)
    - (ii) Black bodies appear under bark; tips of canes die first **Botrytis Cane Wilt** (11)
  - 2. Fruiting canes
    - (i) Canes wilt and die before fruiting; long gray areas with numerous small black pimples **Cane Blight** (12)

(ii) Canes die back from the tips; fruit fails to develop .... **Winter Injury** (17)

b. Spots, discolored areas, or outgrowths on canes
  1. New canes
    (i) Small gray spots with purple borders, appearing in July or August .... **Anthracnose** (4)
    (ii) Purplish areas near bases of branches .... **Spur Blight** (3)
    (iii) Small round or ridged, granular growths in May or June, on black raspberry .... **Cane Gall** (15)
    (iv) Rough, knobby growths on canes of all ages, usually below ground .... **Crown Gall** (16)
  2. Fruiting canes
    Gray areas, with prominent black pimples, at bases of fruit branches .... **Spur Blight** (3)

c. Poor vigor or dwarfing
  1. Canes small and spindly; no apparent leaf symptoms .... **Poor Drainage** (18)
  2. Poor growth; leaves usually discolored .... **Mineral Deficiency** (19)
  3. Poor vigor; rotting of crown and roots .... **Crown and Root Rot** (14)

C. Symptoms on fruit

a. Gray mold on ripe fruit .... **Botrytis Cane Wilt** (11)

b. Fruit misshapen
  1. Irregular, one-sided berries with black spots .... **Anthracnose** (4)
  2. Entire fruits or several drupelets turn brown .... **Anther and Stigma Blight** (13)

c. Fruit becomes crumbly
  1. Loganberry: green fruit becomes dry and crumbly; ripe fruit, dry and flaccid .... **Dry Berry** (21)
  2. Few drupelets; ripe fruit crumbly .... **Crumble Berry** (22)

d. Fruit fails to mature
  1. Gray area at base of fruiting branch .... **Spur Blight** (3)
  2. No visible symptoms on canes .... **Winter Injury** (17)

e. Gray, dull surface on ripening fruit .... **Sun Scald** (20)

Key to the insects and mites — see page 30

CONTENTS

General Recommendations 5
Cautions 5
Virus Diseases
- Mosaic 6
- Leaf curl 6
- Other viruses 6

Fungus Diseases
- Spur blight 8
- Anthracnose 8
- Leaf spot 9
- Yellow rust 9
- Late yellow rust 9
- Orange rust 9
- White rust of blackberry 10
- Powdery mildew 10
- Verticillium wilt 10
- Botrytis cane wilt 10
- Cane blight 11
- Anther and stigma blight 11
- Crown rot and root rot 11

Bacterial Diseases
- Cane gall 11
- Crown gall 11

Troubles of Nonparasitic Origin
- Winter injury 12
- Poor drainage 12
- Mineral deficiency 12
- Sun scald 12

Troubles of Unknown Origin
- Dry berry 13
- Crumble berry 13

Nematodes 13
Insects and Mites
- Raspberry fruitworm 13
- Strawberry leaf beetle 14
- Strawberry weevil 15
- Oblique-banded leaf roller 15
- Raspberry sawfly 15
- Rose chafer 16
- Leafhoppers 16
- Spiders mites 17
- Blackberry leaf miner 18
- Thrips 18
- Redberry mite 19
- Raspberry cane borers 19
- Raspberry cane maggot 20
- Burdock borer 20
- Red-necked cane borer 20
- Rose stem girdler 21
- Tree crickets 21
- Raspberry crown borer 22
- Root weevils 23
- Western white grub 25
- Eastern white grubs 26
- Wireforms 26

Acknowledgments 27
Inquiries 27
Scientific Names of the Diseases and Insect Pests 28

DISEASES AND INSECT PESTS OF RASPBERRIES AND OTHER CANE FRUITS

G. C. Chamberlain,[1] W. L. Putman,[2] and A. T. Bolton[3]

In most parts of Canada, some diseases and insects attack cane fruits every year. They weaken the plants, reduce the yield, and lower the quality of the fruit. One pest may do a great deal of damage in one growing season, and another the next season. Cultural practices are important in combating disorders and inspect pests. Often they are the most practical, and sometimes the only control measures known. Sprays help greatly to prevent losses in seasons particularly favorable for the development of disease or of insects. Watch plantings closely and apply recommended treatments promptly when outbreaks threaten. As better means of control are constantly being devised, consult the latest spray calendar issued by your provincial department of agriculture. Some provinces also have extension horticulturists or fieldmen who can help you on pest control problems.

Unless otherwise mentioned, the diseases and insects attack both red and black raspberries and all other cane fruits, and the symptoms are much the same. All of the diseases are common across Canada unless otherwise stated.

GENERAL RECOMMENDATIONS

Select a well-drained, open site for the plantation, at least 500 feet from old plantings and wild raspberries. Space the rows eight feet apart and keep them from becoming too thick and wide. Remove and destroy old canes as soon as the fruit is harvested. At the same time, thin the rows by removing surplus and weak canes and those with extensive scars, cracks, or swellings. Burn all prunings promptly. Keep the rows free from weeds and follow recommended cultivation practices. Use the best available planting stock. As tomatoes, potatoes, eggplants, and peppers are very susceptible to verticillium wilt, do not plant them in the rotation immediately before raspberries. They may cause the fungus to build up in the soil and endanger succeeding crops.

CAUTIONS

Follow closely all the directions and cautions on the pesticide label, especially those on rates of application of the poison. An interval is required between the last application and harvest for some of the foliage treatments. The interval varies with the material used, the number of applications, and the amount applied. Keep to the interval given to avoid residues that would render the berries unfit for sale. Use an approved respirator and rubber gloves when handling dangerous insecticides.

---

[1] Research Station, Vineland Station, Ontario; died May 31, 1963.

[2] Research Station, Vineland Station, Ontario.

[3] Central Experimental Farm, Ottawa.

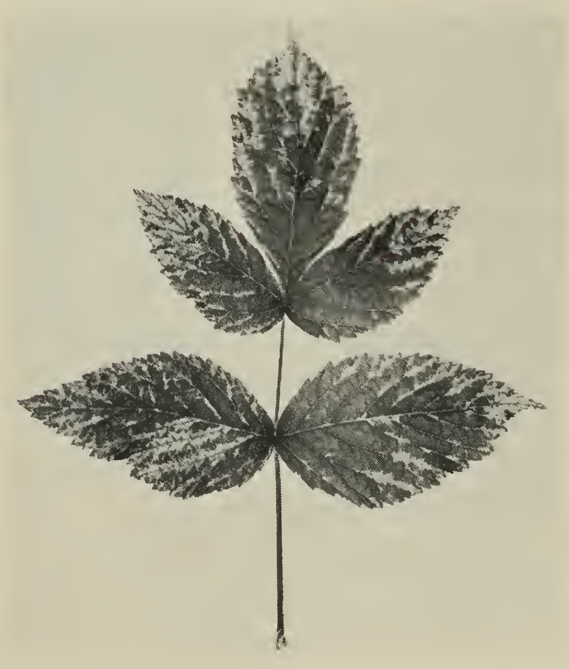
VIRUS DISEASES

Virus diseases are major problems in raspberry plantations. Usually those that affect raspberries do not affect other fruit crops, even other cane fruits. They cannot be controlled with chemicals. Most of the raspberry viruses are spread from infected to healthy plants by aphids. Two kinds of aphids colonize raspberries: a large one that spreads mosaic and a small one that spreads leaf curl. Both species are inconspicuous and cause no appreciable damage by their feeding alone. But they spread the viruses readily when they move from infected to noninfected plants. Once they introduce the virus into susceptible tissue by feeding, it multiplies rapidly and invades all parts of the plant.

(1) Mosaic

Mosaic is the most widespread virus disease of raspberries. It is distinguished by a mottling of the foliage (Figure 1), especially in spring. The tissue along the veins becomes yellowish, that between the veins puckers, and the leaf edges curl down and become distorted.

Figure 1. — Leaf mottling caused by mosaic.



It is hard to see the symptoms on leaves produced during the summer. Under good growing conditions, affected plants produce a reasonable crop of fruit for several years. Under poor conditions, the mosaic plants become more and more stunted each year and the fruit is small and crumbly.

(2) Leaf Curl

This virus disease is less common than mosaic. The small raspberry aphids feeding on infected plants move a shorter distance than the large aphids and the virus is spread slowly in the field. In the main raspberry-growing areas in coastal British Columbia, this aphid does not occur and therefore the region is free from the disease.

Fruiting laterals on infected plants are numerous and short and grow rather upright. The foliage is small, tightly curled, and yellowed. New canes are stunted and numerous and have many branches. The plants remain stunted (Figure 2) and die during the winter or, if they survive, are very weak. Fruit on affected plants is small, hard, and crumbly.

Other Viruses

Several viruses of minor importance affect raspberries in Canada. One, spread by the large raspberry aphid, is found in all clones of some older varieties. Affected plants show only a mild mottling of the foliage in the

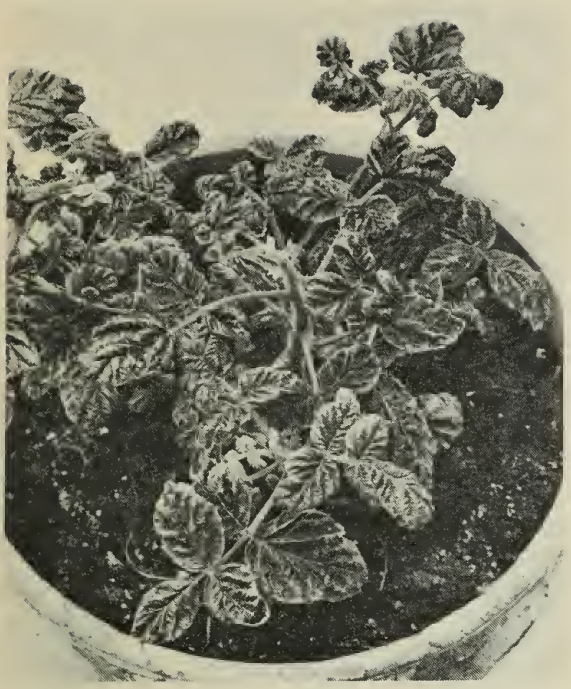


Figure 2. — Raspberry plant infected with leaf curl.

spring. It is hard to identify this disease in the field. Plants that have been rendered free from this disease by growing them at a high temperature for a few days serve as a source for propagating virus-free stock.

Another virus disease affecting raspberries causes a ringspot marking of the foliage. Some leaves also have yellowish blotches and a netlike mottling along the smaller veins. Symptoms are distinct in the spring but plants appear normal during the summer. This disease occurs in small, local areas across Canada. It is spread by nematodes that feed on the roots of the plants.

Control

The widespread losses caused by raspberry virus diseases show that the usual control methods are either inadequate or not used properly. But these diseases are not easy to control and many plantings become infected despite extreme care. The following recommendations, however, should help to prevent serious virus problems.

- Set out new plantings with the best available planting stock. Growers often obtain planting stock from fields that have been exposed to infection for several years and are usually, therefore, contaminated. Secure planting stock recommended by horticulturists of your provincial department of agriculture.
- In new plantings, use a single variety rather than a few rows each of several varieties. This precaution lessens the chances of having a virus spread from a diseased variety to virus-free ones.
- Put new plantings as far as possible from old ones to reduce the chances of contamination. But no set distance guarantees freedom from contamination.
- Select a variety known to resist virus infection. Several varieties that do not support colonies of the large raspberry aphids have been developed. These varieties have remained free from mosaic despite nearby sources of infection.
- Inspect new plantings carefully. If you see an occasional diseased plant, rogue it out, removing all infected canes and roots. If you have many diseased plants, roguing is of little value; it is better to destroy the whole planting when it is no longer productive.

FUNGUS DISEASES

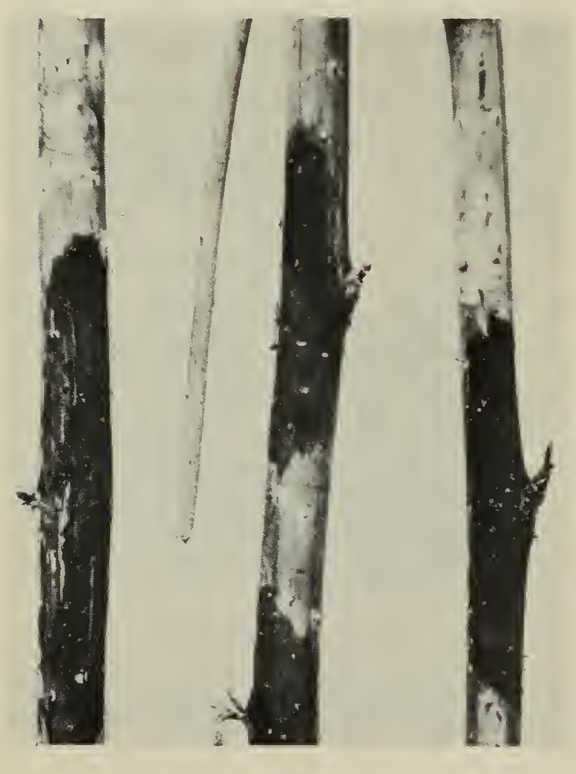
These diseases are caused by fungi that invade the tissues of leaves, stems, fruits, or roots, causing spotting, wilt, rot, or premature leaf drop. The prevalence and severity of these diseases depend greatly on location, weather, and general cultural practices.

(3) Spur Blight

This disease may be severe on all common varieties of red raspberries except Newburgh. It weakens the canes and makes them very susceptible to winter-killing. The destruction of fruiting branches reduces yield.

Symptoms. — Purplish to chocolate-brown areas appear on the young canes directly below the points where the leaves are attached (Figure 3). These colored areas enlarge and may spread to the buds, the leaf stems, and the leaves. The leaves at the infected areas drop. Usually the disease affects the lower half of the plant. On the fruiting canes the diseased areas are gray with small black pimples scattered over the surface.

Figure 3. — Purple-brown lesions caused by spur blight on young raspberry canes.



Control. — Keep the rows 18 to 24 inches wide and well pruned to let the air circulate. If the disease becomes severe, carry out the following spray schedule. When the buds begin to break in the spring, spray with lime-sulphur at 5 gallons in 100 gallons of water or with a 1 percent Elgetol solution. Spray again just before the blossoms open and immediately after harvest with either 76 percent ferbam wettable powder at 2 pounds in 100 gallons of water, or 1½ pounds of fixed copper and 4 pounds of hydrated lime in 100 gallons, at 250 to 300 gallons per acre.

(4) Anthracnose

Anthracnose is common on red and black raspberries. It attacks all above-ground parts of the plant, but is most often found on the canes.

Symptoms. — Small grayish, circular spots with purple borders appear on young canes in July and August (Figure 4). These spots become very numerous and vary in size because several may run together. The bark may crack in the affected area.

Spots may also appear on the fruiting laterals and fruit stems. On the leaves the spots are purple at first, but turn brown and may drop out, leaving a "shot-hole" appearance.

When green fruits are attacked they fail to mature and they dry up. Ripe fruits become brown and the pulp is soft and insipid.

Control. — Good aeration is very important for controlling this disease. Use the spray schedule for spur blight.

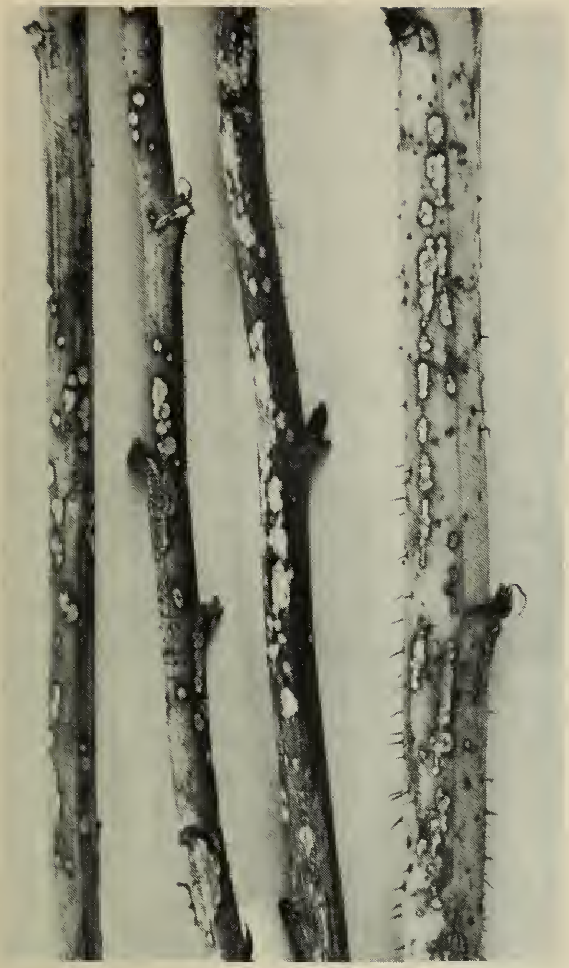


Figure 4. — Anthracnose spotting on black raspberry.

(5) Leaf Spot

Red raspberries, loganberries, boysenberries, and blackberries may be affected by this disease. Heavy defoliation makes the new canes stunted.

Symptoms. — Numerous small, circular spots appear on the leaves and stems. These are reddish brown at first but later spread and change to gray. The leaves fade, become brittle, and drop. The symptoms are usually most conspicuous on the lower leaflets in late summer.

Control. — If the disease becomes serious, spray with 4 gallons of lime-sulphur in 100 gallons of water at the bud-bursting stage. Later, applications of 50 percent captan wettable powder at 3 pounds in 100 gallons of water may be necessary.

(6) Yellow Rust and Late Yellow Rust

Both of these diseases occur on red raspberries. If the disease is severe, the leaves drop prematurely and poor growth results. Wet seasons favor rust development. Viking is especially susceptible to both diseases. Latham, Newburgh, Willamette, Sumner, and Puyallup are resistant.

Symptoms. — Clumps or pustules of light-orange spores develop on the undersides of the leaves, and sometimes on the fruit. The infected leaves turn yellow and drop. If the disease is yellow rust, the leaves may drop before fruiting and prevent the crop from ripening properly. Late yellow rust does not affect the plants until July and August.

Control. — Destroy infected leaves to reduce the source of infection. Cut out fruiting canes at ground level. Since one stage of the disease occurs on white spruce, be aware that rust may be serious in plantings near these trees. Where conditions warrant, use the spray schedule for spur blight.

(7) Orange Rust

This disease affects the blackberry and occasionally the black raspberry, but not the red or purple varieties. It is a serious disease, as affected plants never recover or produce fruit. The fungus invades all tissues, including the crown, and will appear on new shoots year after year.

Symptoms. — Diseased plants produce an abnormally large number of stunted shoots, without spines. These shoots grow in upright bunches. White, blisterlike pustules appear on the undersides of the leaves. These later break open to expose masses of bright-orange spores.

Control. — Rogue and destroy diseased plants in the early spring before the leaf blisters burst. Destroy wild black raspberry and blackberry plants near the plantation. In Ontario, Lowden has shown resistance to this disease.

(8) White Rust of Blackberry

This disease occurs on the cut-leaf evergreen blackberry in British Columbia.

Symptoms. — Small yellow pustules, often fading to white, appear on the leaves and fruit. Yellowish streaks show on the canes.

Control. — Remove and burn old canes. Get rid of fallen blackberry leaves by plowing them under in late fall or early spring.

(9) Powdery Mildew

Most raspberry varieties are susceptible to this disease. It develops most rapidly during warm, humid weather.

Symptoms. — The young canes are stunted, somewhat distorted, and spindly. The leaves become covered with a white powdery fungus, which is more dense on the undersides. The leaves may develop yellow areas that can be mistaken for the virus disease mosaic.

Control. — Select locations with well-drained soil. Spray with dinocap wettable powder at 1 pound of the active ingredient in 80 gallons of water per acre, after harvest or on nonbearing plantations. Repeat the application at 7- to 10-day intervals as long as you see symptoms.

(10) Verticillium Wilt

This disease affects black and red raspberries. The fungus may live in the soil for several years. It attacks the plants through the roots and causes wilting and sometimes death. Poor drainage and cool wet weather favor the disease. All varieties of black raspberries are highly susceptible.

Symptoms. — These appear suddenly with the onset of warm, dry weather; the leaves wilt, turn yellow, and drop. The leaf drop progresses from the bottom upward until only a tuft of small brownish leaves is left at the tip. The cane usually becomes dark blue or purple.

Control. — Select a well-drained site for planting. Do not plant after tomatoes, eggplants, peppers, or strawberries. Carefully dig out and destroy infected plants.

(11) Botrytis Cane Wilt

This disease is most destructive in wet seasons in plantations where growth is rank and dense.

Symptoms. — Numerous black bodies called sclerotia about 1/16 inch wide and 1/4 to 1/2 inch long are scattered along affected new canes just below the bark. In the spring, these break through the bark and drop to the ground. A gray, moldy growth can be seen on the sclerotia at this time as well as on the ripening fruits. The affected drupelets fail to fill out, and become gray and dry. Infected new canes wilt and the tips die.

Control. — Cut out and destroy affected canes. Do not let the canes become too thick in the row. Apply one or more sprays after bloom, using 50 percent captan wettable powder at 3 pounds in 100 gallons of water.

(12) Cane Blight

This disease does little damage in well-cared-for plantations. Infection takes place through injuries caused by insects, top-pruning, etc. It sometimes follows spur blight and anthracnose damage.

Symptoms. — The fruiting canes wilt and die between blossoming and fruiting. Infected canes show long, smoky-gray cankered areas covered with tiny black specks.

Control. — Avoid injuring the plants. Promote good vigor by proper cultural practices. Control spur blight and anthracnose. Prune and burn old canes immediately after harvest.

(13) Anther and Stigma Blight

This disease causes considerable damage to cane fruits in parts of British Columbia.

Symptoms. — A white fungus growth appears on the open flower. Affected fruits are small and dry. The entire fruit or only a few drupelets may turn brown. Fruits that have been partly infected are malformed.

Control. — Keep plants well aerated. No other control measures are known.

(14) Crown Rot and Root Rot

Under certain conditions, several disease organisms that live in the soil can cause the roots and crowns to rot. Unfavorable soil conditions such as poor drainage make the plants susceptible.

Symptoms. — Affected plants are weak and dwarfed, and have poor color and dry, scorched leaves. They develop few fibrous roots and the main roots show black, dead areas.

Control. — Do not plant raspberries on heavy, poorly drained, lowland soils. Improve the drainage by tilling and by breaking up the subsoil between the rows each year before heavy fall rains.

BACTERIAL DISEASES

Only two diseases caused by bacteria are serious on cane fruits.

(15) Cane Gall

Cane gall is found mostly on black raspberries, but may occur on blackberries, red raspberries, and boysenberries.

Symptoms. — Small, round growths or elongated ridges of white granular tissue appear on the fruiting canes in May or June. Later in the season these growths turn black and disintegrate. The canes often split along the ridges and the leaves drop. The fruit on infected canes dries up before ripening. New shoots do not show symptoms.

Control. — Do nott use canes arising from infected plants for setting out. Remove infected plants as soon as you notice the galls.

(16) Crown Gall

This disease attacks raspberries, blackberries, loganberries, and boysenberries. Infection takes place through injuries to the roots and crowns.

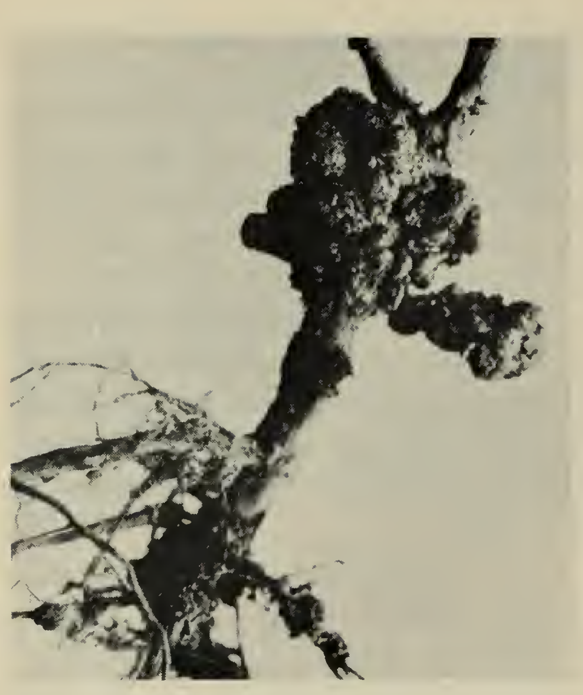


Figure 5. — Crown gall on Columbian cane.

Symptoms. — Round, white, slightly roughened knots develop on the roots and crown. On the roots, the galls grow to about an inch in diameter, turn brown, and decay. On the crowns they may become rather large (Figure 5).

Control. — Carefully inspect plants for galls before planting. Do not plant in soil known to be infested with galls. Avoid injury to the crown and roots when planting or cultivating. Dig up and burn infected plants.

TROUBLES OF NONPARASITIC ORIGIN

(17) Winter Injury

This is caused by low winter temperatures and cold, drying winds; by alternate spells of cold and mild weather; by late-season immaturity; and by excessive soil moisture in the fall or spring.

Symptoms. — Fruiting canes usually produce blossoms, but berries fail to develop. If berries are formed they dry up before ripening. Canes may wilt and die soon after leaves are formed.

Control. — Do not fertilize or cultivate late in the fall as this causes late growth and predisposes canes to winter-killing. Cutting back the canes in late summer has the same effect. Avoid planting in areas exposed to prevailing cold winds in winter.

Varieties differ in resistance to low temperature. In Ontario, Latham is the most winter-hardy. Blackberries are particularly tender. Loganberries and boysenberries cannot withstand low temperatures.

(18) Poor Drainage

Raspberries need abundant soil moisture, but will not tolerate excessively wet conditions. When the roots are too wet, they do not develop properly and the whole plant is weakened.

Symptoms. — The canes are small, the leaves turn yellow and die, and then the whole plant dies.

Control. — If natural drainage is poor, improve it by ditches or tile. Avoid planting in areas where water stays on the surface for long periods in spring or after rains.

(19) Mineral Deficiency

Unthrifty growth and discoloration of leaves often are signs that nutrients are lacking or poorly balanced in the soil. If this occurs, have the soil analyzed and apply the proper fertilizer.

(20) Sun Scald

Sun scald often develops on the ripening fruit during hot, sunny

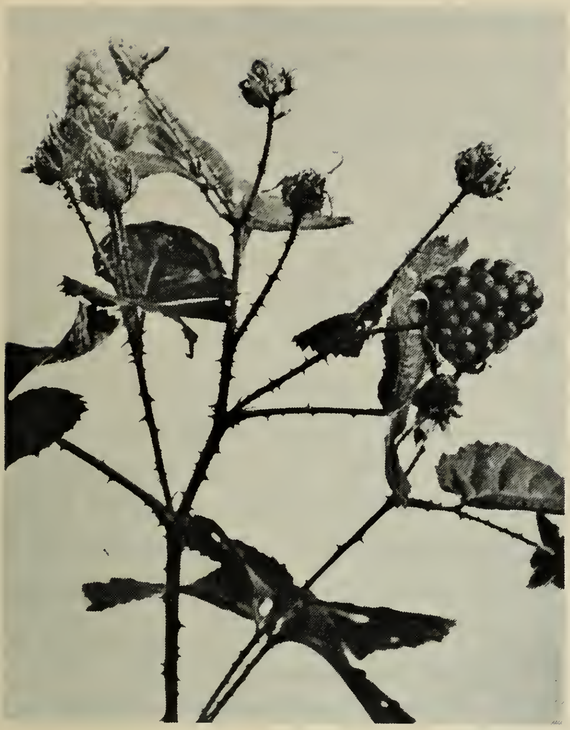


Figure 6. — Dry berry, on loganberry.

weather. The exposed surface of the fruit becomes discolored at first and later turns gray and dull.

TROUBLES OF UNKNOWN ORIGIN

(21) Dry Berry

Dry berry is a destructive disease of loganberries. As much as 90 percent of the fruit may be damaged. The disease first attacks the drupelets and then spreads down into the fruit stems. Green fruit becomes dry, brown, and crumbly. Ripening fruit is dry and flaccid (Figure 6). The cause of the disease is unknown. No control is known.

(22) Crumble Berry

This disease is distinguished by a small number of drupelets and crumbly ripe fruit at picking time. It seems to be prevalent in plantings where virus diseases are common and is also influenced by weather and growing conditions. No control measures can be recommended.

NEMATODES

Nematodes have been found in association with root rot and decline of raspberries. One group of nematodes, *Pratylenchus* species, enters the roots and may stay for a considerable time. All stages in the life cycle of the pests are found in the roots. Another group, including *Paratylenchus, Xiphinema, Criconema,* and *Criconemoides* species, lives in the soil and feeds on the roots by piercing the protective layers. This injury makes it easy for root-rotting fungi and other organisms to enter the roots.

Symptoms. — Affected plants are dwarfed and the leaves are small and bunchy, have poor color, and drop early. Fruit production is below normal. In the spring, brown to reddish areas on the white rootlets show that nematodes are present. Later, many rootlets die and the roots remain sparse and bunchy.

Control. — Select healthy, vigorous stock with clean, bright-colored roots. On land known to be infested, include one year of complete fallow in at least a four-year rotation between cane crops. It is best to fumigate infested land with an approved nematocide.

INSECTS AND MITES

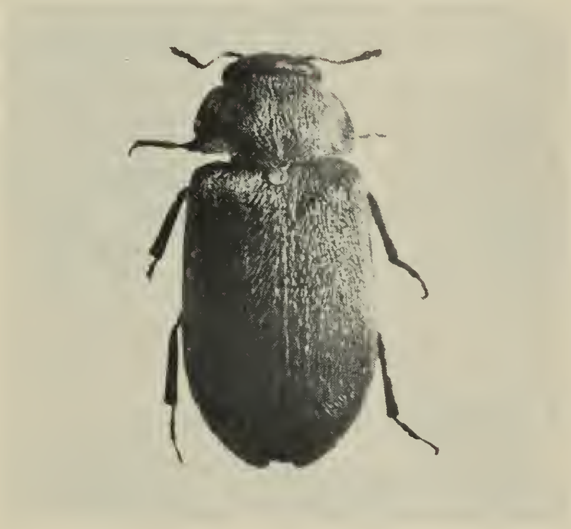
(1) Raspberry Fruitworms

The Western raspberry fruitworm is a serious pest of raspberries and loganberries in the lower Fraser Valley in British Columbia. The eastern raspberry fruitworm occurs in Eastern Canada and occasionally causes injury. A species, probably one of the above, is found in the Prairie Provinces and has been reported as injurious in Saskatchewan.

Injury. — Injury is of two types: (1) the adult beetles skeletonize the young, unfolding leaves, destroy the blossom clusters, and eat holes in the expanding blossom buds; and (2) the small larvae feed within the flower buds and the developing fruit. In raspberries they are generally found between the receptacle, or core, and the berry; in blackberries and loganberries they stay in the picked fruit and make it unfit for sale.

Habits and life history. — The adult beetles (Figure 7) are elongate-oval, a sixth of an inch long, yellowish brown, and covered with fine short hairs. They emerge from the soil when the raspberry buds start to grow. They feed on the expanding leaves and blossoms and lay eggs at first on or near the blossom clusters and later on the green berries. The young larvae enter the blossoms or young fruits and feed on the fleshy cores. The mature larvae drop and burrow under the surface of the soil, where they pupate. The adults are formed during the summer but stay in the soil until the next spring.

Figure 7. — Adult of a raspberry fruitworm. About 17 times natural size.



Control. — Spray with 25 percent DDT emulsible concentrate at 3 pints in 100 gallons per acre, or 50 percent wettable powder at 2 pounds; or use 5 percent DDT dust at 25 to 35 pounds per acre. Spray or dust when the blossom buds are separating in the cluster and again three weeks later or just before bloom. Often the first application is enough.

(2) Strawberry Leaf Beetle

The strawberry leaf beetle occasionally attacks raspberries in Ontario and Quebec.

Injury. — The adult beetles attack the bursting buds in the spring, destroying them or riddling the young leaves. They may destroy all the buds and kill the canes.

Habits and life history. — The adults are shiny, dark-brown or black, oval beetles about an eighth of an inch long. They spend the winter under fallen leaves, sod, or debris in wasteland and woodlands. In the spring they emerge and attack the foliage of various plants. The females lay eggs in the soil and the larvae feed on roots.

Control. — As soon as you notice damage, spray thoroughly with lead arsenate at 5 pounds in bordeaux (5-5-100).

(3) Strawberry Weevil

The strawberry weevil is a well-known pest of strawberries that occasionally attacks raspberries in Eastern Canada.

Injury. — The adult weevils cut through the stems of the blossom buds, causing them to wilt and drop off or to hang by a thread.

Habits and life history. — The adults are small, reddish-brown or blackish snout beetles about a tenth of an inch long. They pass the winter under fallen leaves and debris in the plantation. When the blossom buds are forming in the spring, the female lays an egg in the bud and then cuts the stem just below the bud so that it either falls or is left hanging by a shred of tissue. The larvae develop in fallen buds on the ground and the adults emerge in late summer.

Control. — Apply a 5 percent DDT dust at 40 to 50 pounds per acre as soon as the injury to the buds is noticed.

(4) Oblique-banded Leaf Roller

The oblique-banded leaf roller is a pest of raspberries mainly in British Columbia. In most seasons it causes little damage but occasional outbreaks occur.

Injury. — The slender green caterpillars fold the leaves together or web the tips of growing shoots and feed in the shelter thus formed. The most serious injury is caused when the caterpillars feed on the fruit.

Habits and life history. — The immature larvae, about an eighth of an inch long, overwinter in silken cocoons under the bark and bud scales. In the spring they emerge and feed on the leaves, and mature in June. They pupate within the folded leaves. The moths are reddish brown with oblique dark bands across the wings. They emerge in late June or July and lay eggs on the leaves.

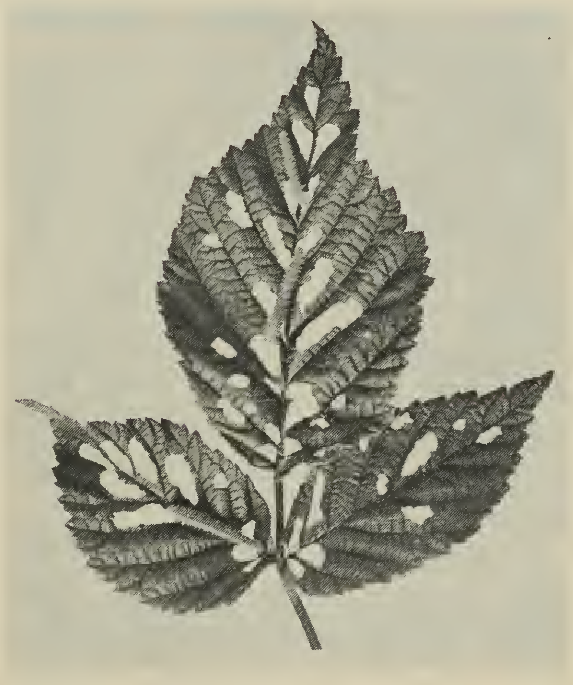
Control. — Remove and burn the old canes after harvest. Where the infestation is severe, dust with 5 percent DDT at 20 to 30 pounds per acre or spray with 50 percent DDT wettable powder at 1½ pounds in 100 gallons of water during mid-May, when most of the caterpillars have emerged from their overwintering cocoons.

(5) Raspberry Sawfly

The raspberry sawfly is one of the commoner pests of raspberries and at times causes considerable damage.

Injury. — The spiny, pale-green larvae, about half an inch long when full-grown, feed along the outer edges

Figure 8. — Larvae of the raspberry sawfly feeding on foliage.



of the leaves or eat out irregular holes (Figure 8). They may destroy all of the leaf except the larger veins.

Habits and life history. — The adults are black, four-winged flies. They lay their eggs within the leaf tissue. On hatching, the larvae feed on the foliage; when fully grown they drop to the ground and spin cocoons in the soil, where they pass the winter.

Control. — Use DDT: 25 percent emulsible concentrate at 3 pints in 100 gallons per acre, or 50 percent wettable powder at 2 pounds; or use 5 percent dust at 35 to 40 pounds per acre. Make the first application in May when the blossom buds separate and the second one before the earliest blossoms open. The first application may be enough.

(6) Rose Chafer

In parts of southern Ontario with light, sandy soil, the rose chafer may damage raspberries severely.

Injury. — The adults feed on the leaves and blossoms in June and early July and, when abundant, may strip the plants.

Habits and life history. — The rose chafer passes the winter as a grub in the soil, 6 to 18 inches deep. Usually the adults begin to emerge from the soil early in June and continue to emerge for about a month. They are slender, fawn-colored beetles about three quarters of an inch long. They lay eggs only in sandy soil, usually in grasslands or grainfields and sometimes in vineyards.

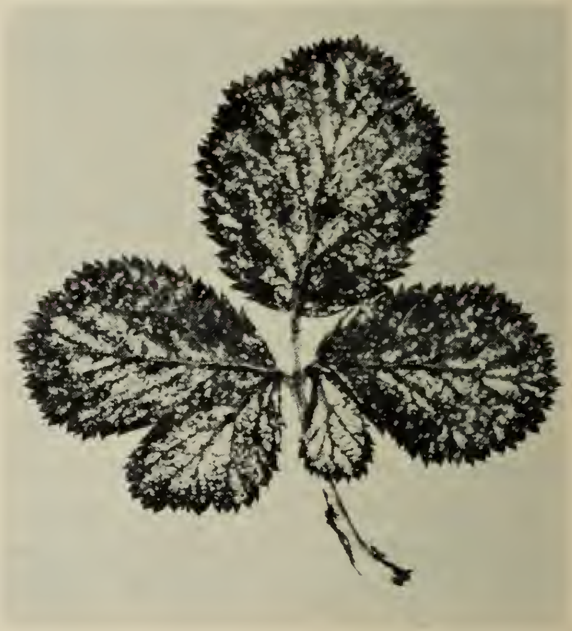
Control. — The rose chafer breeds only in light, sandy soil in waste areas, idle farms, or vacant fields or lots. Get rid of as many breeding grounds as possible by cultivation and seeding to alfalfa or sweet clover. Keep orchards and small fruit patches well cultivated. Practice a short rotation, with clover replacing grasses.

(7) Leafhoppers

Three leafhoppers injure cane fruits: the rose leafhopper, the bramble leafhopper, and a third species known only by its scientific name, *Macropsis fuscula* (Zetterstedt). The rose leafhopper is found wherever cane fruits are grown in Canada but is seldom destructive in the east. The bramble leafhopper and *M. fuscula* are found only on Vancouver Island and in the lower Fraser Valley of British Columbia.

Injury. — The bramble and rose leafhoppers suck the sap from the leaves, which become speckled with small white dots (Figure 9). The entire leaf becomes mottled or whitish when the leafhoppers are abundant. They

Figure 9. — Leaf damaged by nymphs and adults of the bramble leafhopper.



weaken the plants and lower the yield, the fruit being small.

The nymphs of *M. fuscula* feed mostly on the flower buds and fruit. They also deposit honeydew on the leaves and fruit. A sooty fungus grows in the honeydew and lowers the quality of the fruit. Often nymphs are picked with the fruit and they may make the crop unfit for sale.

Habits and life history. — The bramble and rose leafhoppers have two broods each year. Both nymphs and adults are found on the undersides of the leaves (Figure 10). They overwinter as eggs laid just beneath the bark of the canes. Small wingless nymphs hatch from the eggs in mid-May and crawl up to the leaves to feed. In June they change into adults, which are whitish to pale green, about an eighth of an inch long, and winged. The adults lay eggs in the fruiting stems.

M. fuscula has only one brood each year. The eggs overwinter in the bark of the canes. The nymphs hatch from the eggs from late May to late June. They are pale yellow or green and have hairy bodies. They are found mostly on stem ends of flower buds and fruit. The adults appear in July and are about three sixteenths of an inch long, grayish yellow or brown, and wedge-shaped. They feed mostly on the new canes, where they also lay their eggs.

Control. — Use cultural practices that promote vigorous plants. Remove and burn old canes in October after the overwintering eggs have been laid. For the bramble and rose leafhoppers, use DDT when the blossom buds are beginning to separate. Spray with 25 percent emulsible concentrate at 3 pints in 100 gallons of water, or 50 percent wettable powder at 2 pounds; or apply 5 percent dust. Apply the spray at 100 to 150 gallons per acre and the dust at 25 to 35 pounds per acre.

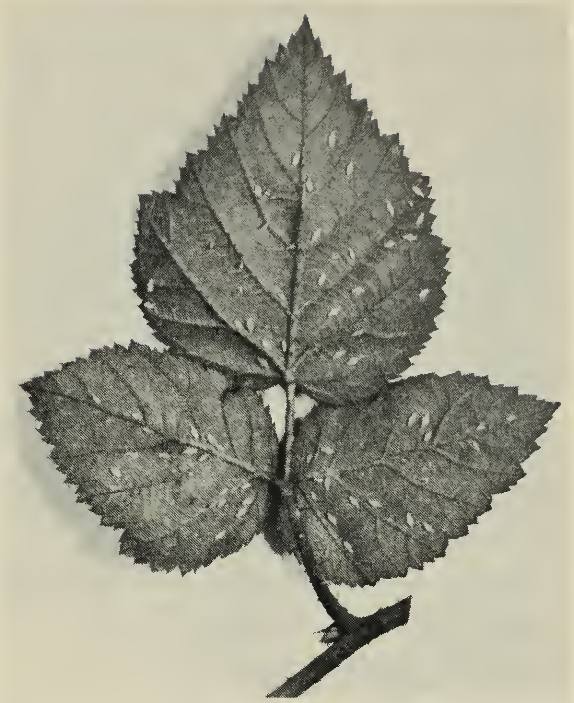


Figure 10. — Nymphs of the bramble and rose leafhoppers on the underside of a loganberry leaf.

Where *M. fuscula* is a problem, add malathion to the DDT. Use 50 percent emulsible malathion at 2 pints in 100 gallons per acre or the 80 percent concentrate at 1 pint, or use a 5 percent dust at 30 pounds per acre.

(8) Spider Mites

Spider mites are among the most troublesome pests of raspberries. The two-spotted spider mite occurs in practically all raspberry-growing areas. The Pacific spider mite is troublesome in the prairies and British Columbia. The McDaniel spider mite has been found in Manitoba. All these species are similar in most respects.

Injury. — Injury first appears as fine whitish or yellowish speckles on the foliage. The mites suck out the juices, and the foliage looks pale and unhealthy. Later the leaves may turn brown and drop. The undersides of the leaves are covered with a fine silken web, and the tiny mites may be seen under it. Injury is usually most severe in hot, dry weather.

Habits and life history. — The adults are barely visible to the eye; during most of the season they are pale greenish yellow but in the fall or on badly injured foliage they may be orange-red. They overwinter under the bark and trash and in the soil at the bases of the canes. When growth starts in the spring they crawl up to the leaves and begin to lay eggs on the undersides. The mites that hatch from these eggs mature rapidly in warm, dry weather. There may be as many as ten generations a year in the warmer parts of Canada.

Control. — In British Columbia, use 18.5 percent Kelthane emulsible concentrate at 2 pints in 100 gallons per acre or 18.5 percent wettable powder at 2 pounds; or 10 percent Tedion emulsible concentrate at 2 pints or 25 percent wettable powder at 1 pound. Spray in May when the blossom buds separate and again 10 days later. In Ontario, spray just before bloom with 50 percent ovex wettable powder at 1 pound in 100 gallons per acre or 18.5 percent Kelthane wettable powder at 1½ pounds.

(9) Blackberry Leaf Miner

The blackberry leaf miner is sometimes very injurious to blackberries in Ontario. Outbreaks lasting three to six years usually alternate with longer periods when the leaf miner is very scarce.

Injury. — The larvae feed between the two surfaces of the leaf, producing large, brown, blisterlike spots. In heavy infestations they may destroy many leaves and the plantation appears brown and scorched. Loss of many leaves reduces the crop and weakens the plants.

Habits and life history. — The adults are black, wasplike insects about a fifth of an inch long. They appear in early June and lay their eggs in the leaves. The larvae are slender, flattened, greenish-white grubs about a third of an inch long. Most of them are full-grown by the end of July and go into the ground, where they spin cocoons. A second brood of adults emerges about mid-August, and larvae from these may be found in the leaves during the rest of the summer. The second-brood larvae overwinter in cocoons in the soil.

Control. — No methods of control are known.

(10) Thrips

In British Columbia, thrips attack most cane fruits and are fairly common. The damage is not extensive, but thrips in the fruit are repulsive and make the crop hard to market.

Habits and life history. — Thrips are minute, slender, winged or wingless insects that jump readily when disturbed. The adults of one species are black; those of another are straw-colored. There are three to five generations each year. The adults overwinter in the soil and debris around the bases of the canes. They emerge in the spring and move to the developing leaves, buds, and flowers where they feed and lay eggs. They are most abundant during July and August.

Control. — Apply DDT in May when the blossom buds separate. Use 25 percent emulsible concentrate at 3 pints in 100 gallons per acre, or 50 percent wettable powder at pounds; or 5 percent dust at 25 to 30 pounds per acre.

(11) Redberry Mite

The redberry mite is one of the most important pests of blackberries on the Pacific coast. Late varieties such as Himalaya and Evergreen are usually most severely injured.

Injury. — Feeding of the mite between the drupelets and the core of the berry causes the drupelets to become hard and to turn bright red, a condition commonly known as "redberry." The entire berry or only some of the drupelets may be affected. Injured berries stay on the canes until the canes die during the winter.

Habits and life history. — The mite is not visible to the naked eye. The adults overwinter in the buds and axils, and lay eggs in early March. There are several overlapping generations during the summer. Some of the mites live in the buds and others enter the fruits and develop between the drupelets.

Control. — In March when the buds are beginning to open, spray with 6 gallons of liquid lime-sulphur in 100 gallons of water. Spray again in May when the fruiting arms are about three to six inches long with 3 gallons of lime-sulphur in 100 gallons of water. Be sure the foliage is dry when you spray. You may use wettable sulphur at 5 pounds in 100 gallons in the second spray.

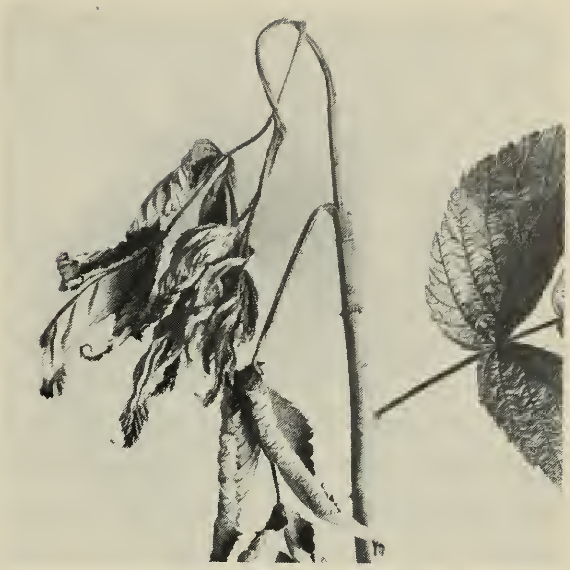


Figure 11. — Tip of raspberry cane killed by the raspberry cane borer.

(12) Raspberry Cane Borers

Raspberry cane borers are widely distributed in Eastern Canada but are especially abundant in Quebec, where they are the most destructive pests of raspberries.

Injury. — In early summer, the tips of the young canes wilt and droop (Figure 11). Just below the withered part, two rows of punctures girdle the cane, about half an inch apart.

Habits and life history. — The adults are slender, cylindrical beetles about half an inch long and have prominent antennae. They are black with yellow collars, which may be either plain or bear two or three black spots. The female girdles the cane with two rows of holes and lays an egg between them. The larva, on hatching, bores into the pith and overwinters not far below the point of girdling. The next season the larva bores on down the cane and passes the second winter at or below the ground level. The next spring it pupates in the cane and the adult emerges in June.

Control. — In most districts all that is usually necessary is to cut off the injured tips well below the lower girdles as soon as you notice them. Removing the old fruiting canes promptly helps greatly in reducing the infestation. Where these measures do not prevent serious injury, spray just before the blossoms open with 50 percent DDT wettable powder at 2 pounds in 100 gallons per acre.

(13) Raspberry Cane Maggot

Although widely distributed, the raspberry cane maggot seldom causes serious injury except in British Columbia, where it is a sporadic pest.

Injury. — In the early spring the new shoots or canes droop over, shrivel, and dry up. At the point where the cane bends is a bluish ring where the maggot has girdled the cane inside.

Habits and life history. — The adult closely resembles the house fly. In British Columbia it appears in April and lays white eggs singly on the unopened leaves at the tips of the new shoots. The egg hatches in four to six days and the maggot bores down the pith about six inches, then turns outward and girdles the shoot. The part above the girdle soon wilts and dies. The maggot then continues down the pith to the base; when full-grown, it pupates in its tunnel and stays there until the next spring. The shoot may rot off at the base but usually enough of the stub remains to hold the puparium.

Control. — Cut off infested canes several inches below the wilted part as soon as you notice the damage.

(14) Burdock Borer

The burdock borer, one of the common stem borers in weeds and other herbaceous plants, occasionally attacks raspberries. It has been reported most often from Quebec.

Injury. — The larvae bore into the canes and cause them to wilt and die.

Habits and life history. — The adults are yellowish-brown, night-flying moths that appear in late summer and lay their eggs on the stems of weeds. The larvae hatch the following spring and bore into the young shoots of many plants, including raspberries. They are smooth, cylindrical caterpillars about 1¼ inches long when full-grown; they are brown with a white stripe down the back and one along each side. They pupate in the stems and the adults emerge later in the same season.

Control. — Keep plantations and their surroundings free from large-stemmed annual weeds. Remove and burn wilted plants as soon as you notice them.

(15) Red-necked Cane Borer

The red-necked cane borer occurs widely on raspberries and blackberries in Eastern Canada but is seldom a serious pest.

Injury. — Swellings from one to three inches long, sometimes called gouty galls, are found on the cane, the bark on the swellings usually being split lengthwise (Figure 12). Affected canes are weakened and may either die or produce no fruit.

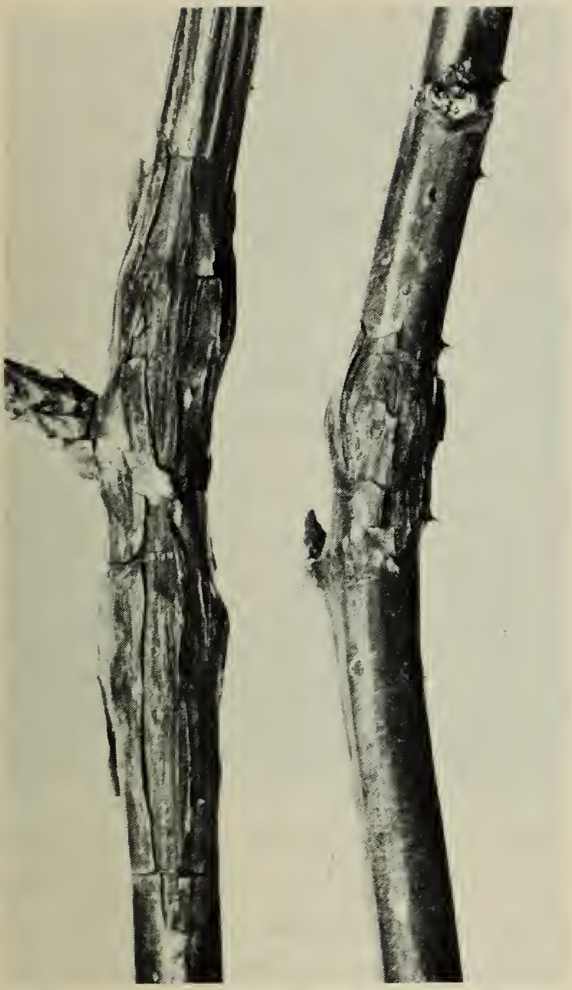


Figure 12. — Canes injured by the red-necked cane borer.

Habits and life history. — The adult beetle is slender, elongate, and about a third of an inch long. It is black with a coppery-red neck. The adults are present from June to August; they feed on the leaves and lay their eggs on the young canes. On hatching, the young larva enters the cane and cuts a spiral tunnel in the wood. The cane usually swells at the point of injury. The larva is a slender, yellowish-white grub about three quarters of an inch long. It hibernates in the pith of the cane. In the spring it pupates and the adult soon emerges.

Control. — Cut out and burn all canes showing the swellings. This usually controls the insect. Where the injury is persistent, spray the plantations just before the blossoms open and again immediately after harvest with 4 pounds of lead arsenate and 4 pounds of hydrated lime in 100 gallons per acre.

(16) Rose Stem Girdler

In southern Ontario this insect occurs on raspberries in spasmodic outbreaks. It may be severe in one year but almost disappear the next.

Injury. — The larvae make spiral tunnelings beneath the bark of the canes that appear at the surface like the threads of a screw. The injury resembles that of the red-necked cane borer but the canes do not usually develop swellings over the tunnels. Injured canes may die above the point of attack or may break off.

Habits and life history. — The adult beetle is similar to the red-necked cane borer but is uniformly dull bronze in color. The life history is similar to that of the above species.

Control. — The measures recommended for the red-necked cane borer will also control the rose stem girdler.

(17) Tree Crickets

The black-horned tree cricket and the four-spotted tree cricket are among the commonest pests of raspberries in Eastern Canada and the Prairie Provinces.

Injury. — The adults insert their eggs deep into the canes in longitudinal rows from one to four inches long. The canes often split and conspicuous scars form along the rows of egg punctures (Figure 13). Injured

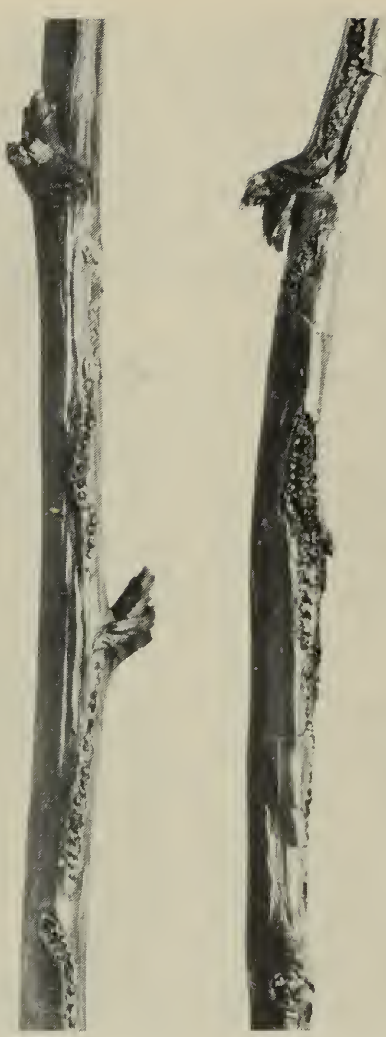


Figure 13. — Egg-laying scars of the black-horned tree cricket.

canes are weakened and the part above the scars may die or break off.

Habits and life history. — The adult tree crickets are whitish or greenish white and about three quarters of an inch long. They lay their eggs in the canes in late summer. The young hatch the next June; they feed mainly on aphids and other soft-bodied insects and reach the adult stage in late summer.

Control. — Remove all canes showing egg scars and also canes that do not leaf out normally. Keep plantations and their surroundings free from weeds and wild raspberries.

Spray with 4 pounds of lead arsenate and 4 pounds of hydrated lime in 100 gallons per acre just before bloom and, if the infestation is heavy, again immediately after harvest.

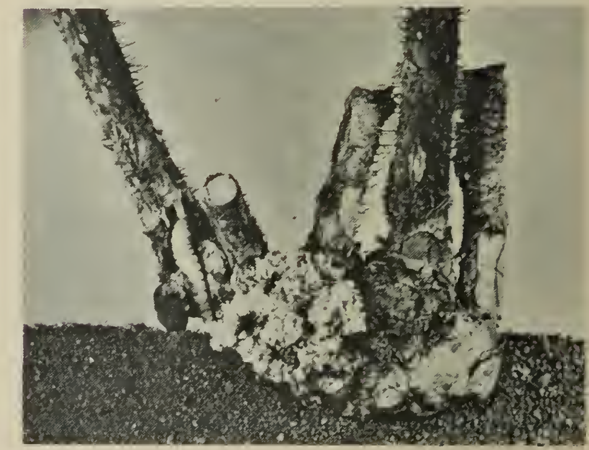
(18) Raspberry Crown Borer

The raspberry crown borer is native to North America and is most common on the Pacific coast.

Injury. — The larvae burrow in the new buds and shoots arising from the bases of the canes in April (Figure 14) and girdle the new canes during the summer. These canes develop galls at the bases, become spindly, and usually break off when handled.

Habits and life history. — The moths resemble wasps (Figure 15). They have yellow bands on the body and clear wings, and often hover near the ground as wasps do. They appear in August, and lay their eggs singly on the undersides of the leaves near the edges. The tiny larvae hatch in September and crawl down the canes to the bases, where they form individual chambers on the canes just below the

Figure 14. — Borings and galls caused by the raspberry crown borer.



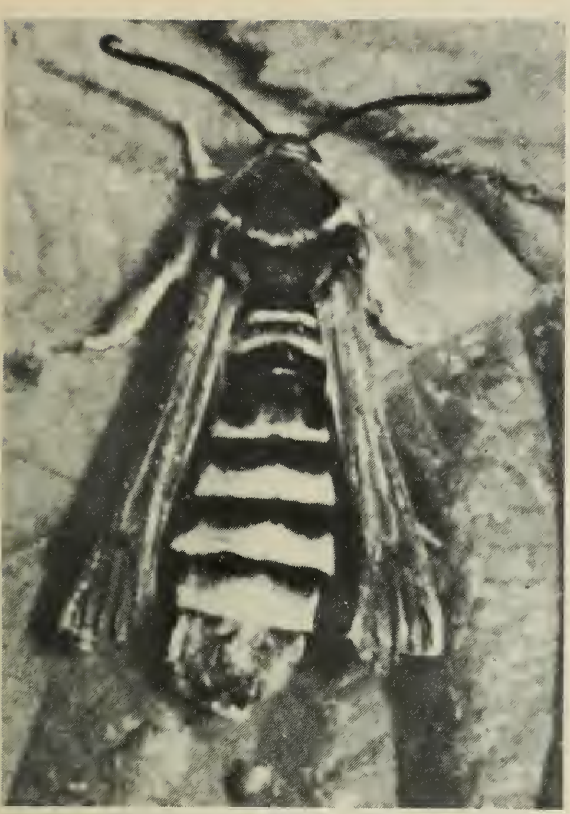


Figure 15. — Adult of the raspberry crown borer.

soil surface and overwinter. The next April they burrow into the canes, damaging the new buds and shoots arising from the bases. During the summer they girdle the bases of the new canes, causing gall-like swellings. By September the caterpillars are about three quarters of an inch long and are white with brown heads. They stay in their burrows over a second winter. During the next summer they tunnel deeper into the fleshy part of the crown. In July, they tunnel upwards a few inches into the fruiting canes and pupate, and in August emerge as moths.

Control. — Apply a drench to the crowns in October or early April. Use 25 percent diazinon emulsible concentrate at 2 pints in 100 gallons. Apply at least half a pint of spray to each crown, or 400 gallons per acre.

When only a few plants are affected, cut off canes with galls at their bases as close to the crowns as possible to expose the larvae in their tunnels, and kill them by crushing.

(19) Root Weevils

European root weevils, including the black vine weevil, the strawberry root weevil, and the clay-colored weevil, as well as the native bush weevil, are serious pests of raspberries and other small fruits in coastal British Columbia. The first three species also occur in Eastern Canada but seldom injure raspberries there.

Injury. — The larvae of all these weevils feed on rootlets and tunnel in the large fleshy roots, making the plants weak and sometimes causing them to wilt. Adults of the bush weevil and clay-colored weevil often climb the dormant canes and destroy the unopened buds from mid-March to early April.

Habits and life history. — The adult beetles have short snouts, elbowed antennae or feelers, and hard-shelled bodies (Figure 16). They have no wings and cannot fly. Those of European origin are shiny black, brown, or gray. The bush weevil is dull brown. All the adults are females; each lays fertile eggs. They climb the canes and feed on leaves or unopened buds after dark.

The larvae are white with brown heads and no legs (Figure 17). They are found in a C-shaped or slightly curled position in the soil around the roots.

The European root weevils overwinter mostly as larvae in the soil though a few adults also overwinter.

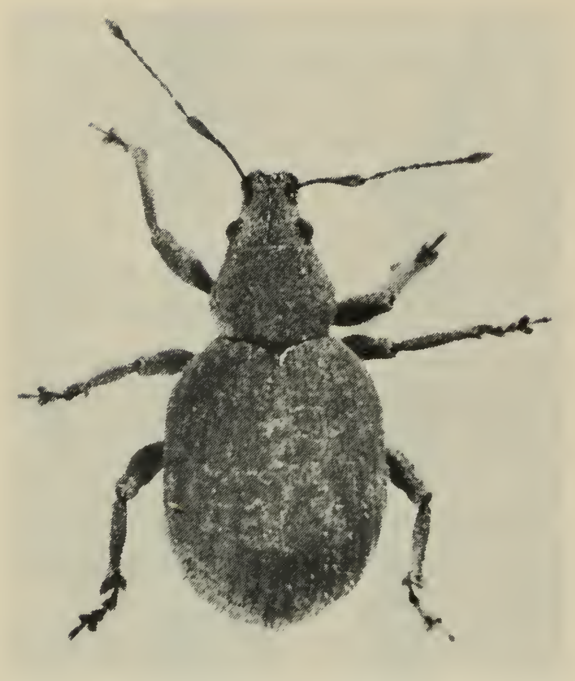
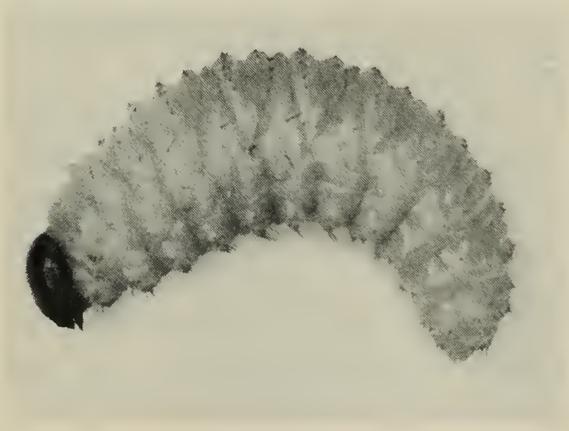


Figure 16. — Adult of the bush weevil.

Adults of the black vine weevil and strawberry root weevil emerge in early June and lay eggs from July to mid-September. Adults of the clay-colored weevil emerge in early April. Adults of the bush weevil emerge at irregular times and lay eggs from March to October. They overwinter as larvae in the soil or as adults at the bases of the canes.

Control. — Set out new plantings as far from raspberry or strawberry plantings as possible and avoid planting after strawberries, or grass or clover sod. Use the following insecticides as sprays for large commercial plantings or as dusts for small plantings.

Figure 17. — Larva of the black vine weevil.



The soil treatment remains effective against the European weevils for at least four years but is not effective against the bush weevil.

Soil treatment for European root weevils: Apply the insecticide to the soil before planting and work it in to a depth of six inches, preferably by rotary cultivator. Use 20 percent aldrin or heptachlor emulsible concentrate as a spray at 2½ gallons in 100 gallons of water per acre, or 2½ percent dust or granules at 200 pounds per acre. Dieldrin is also effective: 20 percent emulsible concentrate as a spray at 1¼ gallons per acre or 2½ percent dust or granules at 100 pounds.

Treatment of established plantings for European root weevils: In old plantings, or five years after the soil was treated, apply a spray or dust to the soil around the bases of the canes and about one foot up the canes in mid-May before fruit forms. Use 20 percent aldrin or heptachlor emulsible concentrate at 1 quart or 20 percent dieldrin emulsible concentrate at 1 pint, in 100 gallons per acre at 100 pounds' pressure. Use the dusts at 25 pounds per acre.

Treatment of established plantings for the bush weevil: In the coastal areas of British Columbia the bush weevil sometimes attacks raspberries planted near wooded areas or strawberry plantings. It is readily detected, since the adults destroy the dormant buds and the canes do not produce fruiting branches. Where this weevil is known to occur, keep a close watch on the dormant canes for bud damage in late March. Use a flashlight at night to tell when weevils are present and spray or dust promptly. Aldrin, heptachlor, and dieldrin do not control it. Apply malathion to damaged and surrounding healthy canes. Use 80 percent emulsible concentrate at 1 pint in 100 gallons per acre, or 5 percent dust at 25 pounds per acre, only to areas where you see damage. Strawberry root weevil bait is very effective against this weevil but deteriorates rapidly and must be applied frequently.

(20) Western White Grub

White grubs, the larvae of a June beetle, are serious pests of raspberries in British Columbia (Figures 18 and 19). They are grayish white, have legs, and are usually curved in a half-circle when at rest. In their most destructive stage they are large and stout and stay in the soil near the dying plants.

Injury. — The grubs feed on the roots, and kill or greatly weaken the canes.

Habits and life history. — The adults are well known as June beetles. In July they lay eggs six to eight inches deep in the soil. These hatch in August and September and the tiny grubs feed on the roots of plants. Later they burrow deeper in the soil and remain dormant until the next spring, when they again feed on the roots. In the second fall, they go deeper and in the spring come up again. The third-year grubs are about two inches long. They do the most damage during the spring of the third year, just before they change to pupae. The adults emerge from the soil in late June and early July.

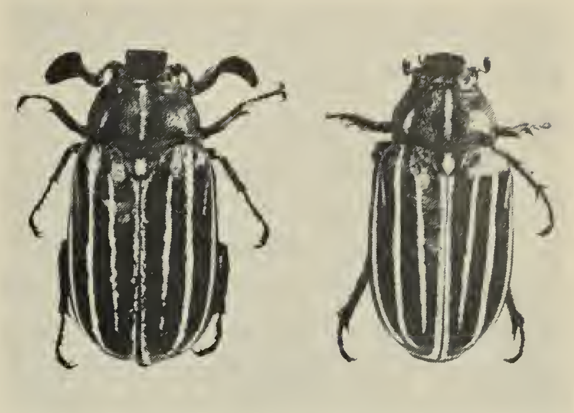
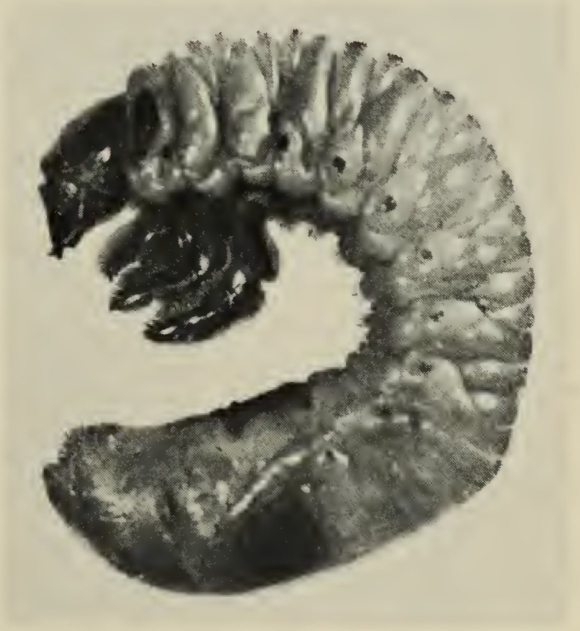


Figure 18. — Adults of the western June beetle.

Control. — Apply a dust containing 2½ percent aldrin or heptachlor, or 5 percent chlordane, to the soil at 200 pounds per acre and plow it in six to eight inches deep. Use a fertilizer cart or spreader to apply the insecticide evenly. These insecticides are effective when applied at any time of the year

Figure 19. — Larva, or white grub, of the western June beetle.



and one application will kill the white grubs for several years.

(21) Eastern White Grubs

Other white grubs are found throughout Eastern Canada, especially in Ontario and Quebec. They may seriously damage young plantations set on infested land, the large, white grubs eating off the roots. Serious infestations are likely to occur only once in three years.

Habits and life history. — The life history differs in only a few details from that of the western white grub found in British Columbia: the grubs do the most damage during their second year. In the third year they do little feeding and soon pupate. The adults mature in late summer but stay in the soil until the next spring.

Control. — Use the same control measures as for the western white grub.

(22) Wireworms

Wireworms occasionally attack new plantings, especially if the land was previously in sod or cover crop. In British Columbia there are four main species: *Limonius discoideus* LeConte, *Limonius infuscatus* Motschulsky, *Ctenicera lobata lobata* (Eschscholtz), and *C. aeripennis* (Kirby).

Injury. — The larvae feed on the roots, weakening the plants.

Habits and life history. — The larvae are yellowish brown, shiny, and slender; they have hard bodies and three pairs of short legs. They may be up to 1½ inches long and about an eighth of an inch thick. The worms live in the soil for three to six years. They pupate during July and August and become adults in about three weeks. The adults, or click beetles, are shiny brown with a hard shell. They emerge from the soil the next spring or early summer and lay eggs in the top six inches of soil. The eggs hatch in three to four weeks.

Control. — Use the soil treatment recommended for European root weevils.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to officers of the research stations and laboratories of the Department in British Columbia, Ontario, and Nova Scotia for their cooperation in reviewing disease and insect problems in their areas. Special thanks are extended to Mr. J. Raine, Vancouver, for preparing or revising some of the insect sections; to Mr. N. V. Tonks, Saanichton, for his assistance; to Mr. W. T. Cram, Vancouver, for his revision of the section on weevils; to Dr. R. Stace-Smith, Vancouver, for the section on virus diseases; and to Mr. W. R. Orchard, Saanichton, for his suggestions on the disease sections.

INQUIRIES

For more information, consult your agricultural representative or provincial specialist, or write to the nearest plant pathology or insect laboratory of the Canada Department of Agriculture or to the Scientific Information Section, Canada Department of Agriculture, Central Experimental Farm, Ottawa.

Some brand names are used in this publication because the chemical names are difficult for general use and there are no official common names for the active ingredients.

SCIENTIFIC NAMES OF THE DISEASES AND INSECT PESTS

Fungus Diseases

Anther and stigma blight	*Hapalosphaeria deformans* Syd.
Anthracnose	*Elsinoë veneta* (Burkh.) Jenkins
Botrytis cane wilt	*Botrytis cinerea* Pers. ex Fr.
Cane blight	*Leptosphaeria coniothyrium* (Fckl.) Sacc.
Crown rot and root rot	*Phytophthora, Pythium,* and *Rhizoctonia* species
Late yellow rust	*Pucciniastrum americanum* (Farl.) Arth.
Leaf spot	*Mycosphaerella rubi* Roark
Orange rust	*Gymnoconia peckiana* (Howe) Trott.
Powdery mildew	*Sphaerotheca macularis* (Wallr. ex Fries) W. B. Cke. (=*S. humuli* (DC.) Burr.)
Spur blight	*Didymella applanata* (Niessl) Sacc.
Verticillium wilt	*Verticillium albo-atrum* Reinke and Berth, *V. dahliae* Kleb.
White rust of blackberry	*Kuehneola uredinis* (Lk.) Arth.
Yellow rust	*Phragmidium rubi-idaei* (DC) Karst.

Bacterial Diseases

Cane gall	*Agrobacterium rubi* (Hildebrand) Starr & Weiss
Crown gall	*Agrobacterium tumefaciens* (E. F. Smith & Town.) Conn.

Insects and Mites

Blackberry leaf miner	*Metallus rohweri* MacGillivary
Black-horned tree cricket	*Oecanthus nigricornis nigricornis Walker*
Black vine weevil	*Brachyrhinus sulcatus* (Fabricius)
Bramble leafhopper	*Ribautiana tenerrima* (Herrich-Schaeffer)
Burdock borer	*Papaipema cataphracta* (Grote)
Bush weevil	*Nemocestes incomptus* (Horn)
Clay-colored weevil	*Brachyrhinus singularis* (Linnaeus)
Eastern raspberry fruitworm	*Byturus rubi* Barber
Eastern white grubs	*Phyllophaga* spp.
Four-spotted tree cricket	*Oecanthus nigricornis quadripunctata* Beutenmueller
McDaniel spider mite	*Tetranychus mcdanieli* McGregor
Oblique-banded leaf roller	*Choristoneura rosaceana* (Harris)
Pacific spider mite	*Tetranychus pacificus* McGregor
Raspberry cane borers	*Oberea* spp.
Raspberry cane maggot	*Pegomya rubivora* (Coquillet)

Raspberry crown borer	*Bembecia marginata* (Harris)
Raspberry sawfly	*Monophadnoides geniculatus* (Hartig)
Redberry mite	*Aceria essigi* (Hassan)
Red-necked cane borer	*Agrilus ruficollis* (Fabricius)
Rose chafer	*Macrodactylus subspinosus* (Fabricius)
Rose leafhopper	*Edwardsiana rosae* (Linnaeus)
Rose stem girdler	*Agrilus rubicola* Abeille
Strawberry leaf beetle	*Paria* sp.
Strawberry root weevil	*Brachyrhinus ovatus* (Linnaeus)
Strawberry weevil	*Anthonomus signatus* Say
Thrips	*Frankliniella moultoni* Hood *Frankliniella occidentalis* (Pergande)
Two-spotted spider mite	*Tetranychus urticae* Koch
Western raspberry fruitworm	*Byturus bakeri* Barber
Western white grub	*Polyphylla perversa* Casey

KEY TO THE INSECTS AND MITES

The number at the right is the one under which the pest is discussed in the text.

A. Attacking the buds in the spring

- a. Elongate, dull-brownish beetles **Raspberry Fruitworms** (1)
- b. Oval, shiny brown or black beetles, in Eastern Canada **Strawberry Leaf Beetle** (2)
- c. Large, black, brown, or gray beetles with snouts **Root Weevils** (19)
- d. Very small dark beetles cutting off blossom buds, in Eastern Canada **Strawberry Weevil** (3)

B. Attacking the foliage

- a. Eating the leaves
  - 1. Slender green caterpillars folding or webbing the leaves **Oblique-Banded Leaf Roller** (4)
  - 2. Small, elongate, dull-brownish beetles skeletonizing young leaves and eating holes in blossom buds **Raspberry Fruitworms** (1)
  - 3. Spiny, green, caterpillarlike insects eating holes in the leaves **Raspberry Sawfly** (5)
  - 4. Large, long-legged, fawn-colored beetles eating the leaves and blossom clusters, in Ontario **Rose Chafer** (6)
- b. Fine white or gray speckling on the leaves
  - 1. Small, whitish or greenish active insects on the undersides of the leaves **Leafhoppers** (7)
  - 2. Very tiny, slow-moving, greenish or yellowish mites living on the undersides of the leaves **Spider Mites** (8)
- c. Whitish grubs feeding between the two surfaces of the leaves of blackberry, in Ontario **Blackberry Leaf Miner** (9)

C. Attacking the fruit

- a. Small whitish grubs in the core or between the core and the drupelets **Raspberry Fruitworms** (1)

b. Slender, green caterpillars .... **Oblique-Banded Leaf Roller** (4)

c. Very tiny, slender, straw-colored or black insects among the drupelets .... **Thrips** (10)

d. Drupelets of blackberries remaining hard and red, in British Columbia .... **Redberry Mite** (11)

e. Leaves and fruit covered with a sticky secretion on which a sooty fungus grows .... **A Leafhopper,** *Macropsis fuscula* (7)

D. Attacking the canes

a. Young canes wilting
  1. Two girdles about half an inch apart, cut in the cane below the wilted part .... **Raspberry Cane Borers** (12)
  2. Only one girdle around the cane, cut from inside the bark .... **Raspberry Cane Maggot** (13)
  3. Large, brownish, striped caterpillar boring in the canes .... **Burdock Borer** (14)

b. Large, elongate swellings on the cane .... **Red-Necked Borer** (15)

c. Spiral tunnels around the cane under the bark .... **Rose Stem Girdler** (16)

d. Rows of closely spaced punctures along the canes, which often split apart .... **Tree Crickets** (17)

E. Attacking the crowns

Whitish caterpillars boring into the crowns .... **Raspberry Crown Borer** (18)

F. Attacking the roots

a. Whitish grubs without legs, up to half an inch long .... **Root Weevils** (19)

b. Large, whitish grubs with legs
  1. In Eastern Canada .... **Eastern White Grubs** (21)
  2. In British Columbia .... **Western White Grub** (20)

c. Slender, hard-bodied, brown or yellowish grubs .... **Wireworms** (22)

LIBRARY / BIBLIOTHEQUE
AGRICULTURE CANADA OTTAWA K1A 0C5
3 9073 00020398 6

DATE DUE
DATE DE RETOUR

OCT - 9 1985
NOV 1 0 1985

LOWE-MARTIN No. 1137

RE

Roger Duhamel, F.R.S.C.
Queen's Printer and Controller of Stationery
Ottawa, 1964

Cat. No: A43-880

15M—31702—12:64